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(54) **Sunblock formulations con-  
taining polyethylene**

(57) A sunblock or sunscreen formu-  
lation contains from 2.0% to 15%  
by weight of the formulation of a  
homopolymer or copolymer (e.g.  
with vinyl acetate) of polyethylene.  
The formulation is preferably a wa-  
ter in oil emulsion and may include  
emulsifiers, emollients and preser-  
vatives, and one or more ultraviolet  
absorbing compounds. The Molecu-  
lar weight of the homopolymer may  
be 1,100 to 2,000, and that of the  
copolymer may be 2,000 to 3,500.

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## SPECIFICATION

## Sunblock formulati n

- 5 Ultraviolet energy absorbed by the human skin can produce an erythema reaction (redness). 5  
The intensity of the reaction is dependent upon the amount of energy absorbed. Ultraviolet radiation from both sunlight and artificial sources has been divided into three bands (UV-A, UV-B, and UV-C) which emit different quantities of energy and therefore produce an erythema reaction at different time intervals after exposure. The amount of energy from any source
- 10 required to produce a minimally perceptible redness reaction of the skin is termed the Minimal Erythema Dose or MED. 10  
UV-A radiation is present in the sunlight reaching the earth's surface and has a wavelength of 320 to 400 nanometers (nm.). It can cause tanning of the skin but is weak in causing reddening of the skin. About 20 to about 50 joules/cm<sup>2</sup> of UV-A energy is required to produce
- 15 one MED. The erythema reaction is maximal in intensity about 72 hours after exposure. 15  
UV-B radiation is present in the sunlight reaching the earth's surface and has a wavelength of 290 to 320 nm. It causes the sunburn reaction which also stimulates pigmentation (tanning) in the skin. Approximately 20 to 50 millijoules/cm<sup>2</sup> of UV-B energy is required to produce one MED (i.e., about 1,000 times less than the dose of UV-A). The erythema reaction is maximal in
- 20 intensity at from about 6 to about 20 hours after exposure. 20  
UV-C radiation has a wavelength of 200 to 290 nm. and is not present in the sunlight reaching the earth's surface but can be emitted by artificial ultraviolet sources. It is not effective in stimulating pigmentation but does cause erythema requiring about 5 to 20 millijoules/cm<sup>2</sup> to produce one MED.
- 25 The tanning ability of an individual is genetically predetermined and is governed by the individual's capacity to produce melanin pigment within the pigment cells when stimulated by UV-B and UV-A. The extent of any erythema response is a function of skin color and thus less time is required to produce a MED in light skinned individuals than to produce a MED in dark skinned individuals. 25
- 30 The most rapid way to cause tanning is to allow the sun to produce erythema of the skin. Erythema sufficient to induce tanning yet not so severe as to cause pain requires only half the time of exposure that is required to produce a painful sunburn. Suntanning can occur at the UV-A wavelengths but develops slowly under natural conditions. Tanning most commonly develops after exposure to the "sunburn" UV-B band. 30
- 35 Sunscreen preparations are commercially available which extend the time it takes the sun to produce a sunburn. Such preparations contain chemicals which can absorb ultraviolet light at various wavelengths, i.e. 2-hydroxy-4-methoxybenzophenone which absorbs UV-A, or an opaque substance that physically reflects or scatters the ultraviolet light, i.e. talc. 35  
Ultraviolet absorbing compounds and sunscreen compositions containing the same are disclosed, for example, in U.S. Patents 3,004,896; 3,189,615; 3,403,207; 3,479,428; 3,644,614; 3,670,074; 3,751,563; 3,821,363; 3,892,844; British Patent 1,291,917; etc.
- 40 Since sunscreen products are often employed by people undergoing physical exertion particularly in warm climates or people who are engaging in water activities, it is desirable to have a product which is moisture resistant. Attempts at formulating such products have included the development of polymeric ultraviolet absorbing compounds and compositions, as note, U.S. Patents 3,666,732; 3,795,733; 3,864,473; 3,895,104; 3,980,617; 4,004,047; etc. 40
- 45 This invention is directed to sun block or sunscreen formulations having enhanced ultraviolet absorbing properties. The formulation is preferably a water in oil emulsion which contains water, emollients, emulsifiers, preservatives, antioxidants, and one or more ultraviolet absorbing compounds. The ultra-violet absorbing property of the formulation is enhanced by including from about 2.0% to about 15% by weight of polyethylene, preferably from about 2.5% to about 6.0% by weight of low density, low molecular weight polyethylene homopolymer. 45
- 50 This invention is directed to a sunblock or sunscreen formulation having enhanced ultraviolet absorption in both the sunburning (UV-B) and tanning (UV-A) regions. The formulation contains one or more ultraviolet absorbing compounds and from about 2.0% to about 15% by weight of polyethylene. Various other ingredients such as emollients, emulsifiers, preservatives, antioxidants, fragrances, coloring agents, etc. can be included within the formulation. 50
- 55 The formulation is preferably a water in oil type emulsion since this affords added moisture resistance to the product. However, the product could also be formulated as an oil in water emulsion, cream base, or oil base. Depending upon the choice of ingredients, the formulation has a semi-soild cream like consistency which can be packaged in a plastic squeeze tube or it has a lotion type consistency which can be packaged in a plastic squeeze container. The container can include a flow type cap or pump type dispenser. 55
- 60 The formulation contains one or more ultra-violet absorbing agents, preferably at least one compound which absorbs in the UV-B region and at least one compound which absorbs in the 60
- 65 c mpound which absorbs in th UV-B r gion and at least one compound which absorbs in the 65

UV-A region. The total amount of UV absorbing agents included within the formulation will be from about 3% to about 15% by weight.

- Suitable UV-A absorbing agents include 2-(2'-hydroxy-5'-methylphenyl)benzotriazole (Tinuvin P); 2-(2'-hydroxy-5'-octylphenyl)benzotriazole (Spectra-Sorb UV 5411); 2,4-dihydroxybenzophenone (Uvinul 400); 2-hydroxy-4-methoxybenzophenone (oxybenzone, Spectra-Sorb UV9, Uvinul M-40); 2,2', 4,4'-tetrahydroxybenzophenone (Uvinul D50); 2,2'-dihydroxy-4,4'-dimethoxybenzophenone (Uvinul® D49); 2,2'-dihydroxy-4-methoxybenzophenone (dioxybenzone, Spectra-Sorb UV24); 2-ethylhexyl-4-phenyl-benzophenone carbonate (Eusolex 3573); 2-hydroxy-4-methoxy-4'-methylbenzophenone (mexenone, Uvistat 2211); 2-hydroxy-4-(n-octyloxy)benzophenone (octabenzene, Spectra-Sorb UV531); 4-phenylbenzophenone (Eusolex 3490); and 2-ethylhexyl-2-cyano-3,3'-diphenylacrylate (Uvinul N539). The UV-A absorbing agent or agents may be present in the final product at from about 0.5% to about 10% by weight of the formulation. The amount will vary according to the particular agent selected and whether the formulation is intended to minimize or permit tanning. The preferred UV-A absorbing agent is 2-hydroxy-4-methoxybenzophenone alone or in combination with 2,2'-dihydroxy-4-methoxybenzophenone.

- Suitable UV-B absorbing agents include 4-(dimethylamino)benzoic acid, ethyl ester; 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester (Escalol 507); 4-(dimethylamino)benzoic acid, pentyl ester (Escalol 506); glyceryl p-aminobenzoate (Escalol 106); isobutyl p-aminobenzoate (Cycloform); and isopropyl p-aminobenzoate. The UV-B absorbing agent or agents may be present in the final product at from about 3% to about 10% by weight of the formulation. The amount will vary according to the particular agent selected and degree of protection desired in the final product. The preferred UV-B absorbing agent is 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester.

- The critical ingredient in the sun block or sunscreen formulations is the presence of from about 2.0% to about 15% by weight of polyethylene, preferably from about 2.5 to about 6% by weight. It has been found that including 2.0% by weight or more of polyethylene results in an enhancement of the UV absorbing properties of the formulation in both the UV-A and UV-B regions. Increasing the amount of polyethylene will result in corresponding increased UV absorption up to about 5.5% by weight polyethylene. Increasing the amount of polyethylene above about 5.5% does not result in appreciable increases of UV absorption above that found at 5.5%. Thus, the upper limit of about 15% by weight polyethylene is based upon the fact that higher amount will result in an undesirable product due to the feel and viscosity of such formulations.

- Suitable forms of polyethylene for inclusion within these sunblock and sunscreen formulations are homopolymers having a low molecular weight of from about 110 to about 2000 and a low density of from about 0.88 to about 0.92 g./cc and copolymers of polyethylene and vinyl acetate having a molecular weight of from about 2000 to about 3500 and a density of from about 0.91 to about 0.93 g./cc. The low molecular weight, low density polyethylene homopolymers are preferred. It is to be understood that, except where the context otherwise indicates references to "polyethylene" include homopolymers of ethylene and copolymers of ethylene with one or more other substances.

- The polyethylene also functions in increasing the moisture resistance and wash resistance of the formulation. The polyethylene also aids in maintaining the stability of the water in oil emulsion and improves the feel and spreadability of the formulation.

- The formulation generally also contains from about 40% to about 65% by weight of water, from about 15% to about 30% by weight of emollients, from about 3% to about 10% by weight of emulsifiers, less than about 1% by weight of preservatives and antioxidants, and less than about 1% by weight of fragrance and colouring agents.

- Suitable emollients include mineral oil, squalane, octyl palmitate, cocoa butter, sesame oil, pristane, etc. The formulation will preferably contain a mixture of several of these emollients or others which are approved for cosmetic use.

- Suitable emulsifiers include polyoxyethylene, (3) oleyl ether (oleth 3), polyglyceryl-4 oleate, polysorbate 80 (Tween 80), etc. The formulation will preferably contain a mixture of two or more of these emulsifiers or others which are approved for cosmetic use.

- Suitable preservatives include a methylparaben (Tegosept M), quaternium-15 (N-(3-chloroallyl)-hexaminium chloride, Dowcil 200), propylparaben (Tegosept P), etc., and the preferred antioxidant is a mixture of butylated hydroxyanisole, propylene glycol, propyl gallate and citric acid (Tenox 2). The formulation will preferably contain the antioxidant mixture and one or more of the preservatives or any other preservatives and antioxidants approved for cosmetic use.

- As discussed above, by varying the percentage of ingredients the formulation can be obtained in a lotion or semi-solid form. For example, in formulation the product as a lotion, water would be included at from about 60% to 65% by weight of the final product and one or more humectants such as propylene glycol, glycerin, 1,3-butylene glycol, sorbitol, or sodium pyroglutamate (sodium PCA) could be included at up to about 7.5% by weight of the final

product.

The process techniques will vary somewhat according to the particular ingredients. In general, the majority of the emollients, emulsifiers, UV-absorbing agents, preservatives, and antioxidants are blended together with moderate mixing and heating to a temperature of above 90°C,

5 preferably at from about 92°C to about 95°C. The polyethylene is then added slowly to the above blend while agitation and heating at above 90°C. Preferably, the polyethylene can first be added slowly with high speed mixing to one of the emollients which was not included in the main blend to completely disperse the polyethylene. This second blend can then be added slowly to main blend with agitating and heating. The mixing is continued until no undissolved  
10 particles of polyethylene are visible and the oily phase is maintained at above 90°C.

The water, preferably deionized water, is heated above 90°C, again preferably from about 92°C to about 95°C. Any water soluble ingredients can be included within this aqueous phase.

The aqueous phase is then added slowly with moderate agitation to the oily phase. After the addition is completed, the agitation is increased and the mixture is maintained at above 90°C.  
15 until the blend is uniform. The blend is cooled in several stages to room temperature with continued agitation, homogenized, and stored or packaged.

Preferred sunblock formulations offering maximum protection according to this invention include from about 50% to about 60% by weight of water, from about 4.5% to about 6% by weight of a low molecular weight, low density polyethylene homopolymer, from about 2.5% to  
20 about 3.5% by weight of UV-A absorbing agents selected from 2-hydroxy-4-methoxybenzophenone (oxybenzone) and 2,2'-dihydroxy-4-methoxybenzophenone (dioxybenzone), from about 5% to about 10% by weight of the UV-B absorbing agent 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester (Escalol 507), from about 20% to about 27% by weight of emollients, from about 4% to about 7% by weight of emulsifiers, and up to about 1% by weight of combined  
25 preservatives, antioxidants, and fragrances.

Most preferably the maximum protection formulation will contain about 55% by weight of deionized water, about 5.5% by weight of a polyethylene homopolymer having an average molecular weight of about 2000 and a density of about 0.92 g./cc., about 2.0 to about 2.5% by weight of 2-hydroxy-4-methoxybenzophenone, up to about 1% by weight of 2,2'-dihydroxy-  
30 4-methoxybenzophenone, about 7% by weight of 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester, from about 23% to about 25% by weight of emollients, about 5% by weight of emulsifiers, and up to 1% by weight of combined preservatives, antioxidants, and fragrances.

Preferred sunscreen formulations which protect but still permit gradual tanning according to this invention contain from about 55% to about 65% by weight of water, from about 2.5 to  
35 about 4.5% by weight of a low density, low molecular weight polyethylene homopolymer, up to about 1% by weight of 2-hydroxy-4-methoxybenzophenone (oxybenzone), from about 3% to about 5% by weight of 4-(dimethylamino)-benzoic acid, 2-ethylhexyl ester (Escalol 507), up to about 7.5% by weight of humectants, from about 20 to about 25% by weight of emollients, from about 4% to about 7% by weight of emulsifiers, and up to about 1% by weight of  
40 combined preservatives, antioxidants, and fragrances.

The most preferred sunscreen formulation which still permits tanning is a lotion containing from about 60% to about 61% by weight of deionized water, about 3.5% by weight of a polyethylene homopolymer having an average molecular weight of about 1500 and a density of about 0.91 g./cc., about 0.6% by weight of 2-hydroxy-4-methoxybenzophenone, about 3.5%  
45 by weight of 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester, about 5% by weight of glycerin or propylene glycol, from about 20% to about 22% by weight of emollients, from about 5% to about 6% by weight of emulsifiers, and up to about 1% by weight of combined preservatives, antioxidants, and fragrances.

The following examples are illustrative of the invention.

50 *Examples 1-4*

Sun block formulations having a sun protection factor (SPF) value greater than 15 are prepared. The SPF value is determined by dividing the minimal erythema dose (MED) for protected skin after the application of 2 mg./cm<sup>2</sup> of the formulation by the MED for unprotected  
55 skin.

The ingredients are listed on a weight percent basis and the chemical, CTFA, and/or trade name are included. All four of these formulations are water in oil type emulsions in a thick lotion form.

	1	2	3	4	
5 Deionized Water	55.00	55.00	55.00	55.00	5
Polyethylene (homopolymer) (Allied Chemical A-C 6A, average molecular wt. 2000, density of 0.92 g./cc.)	5.5	5.5	5.5	5.5	
10 UV-A absorbing agents					10
2-Hydroxy-4-methoxybenzophenone (oxybenzone, Uvinul M-40)	2.5	2.5	2.5	2.0	
2,2'-Dihydroxy-4-methoxybenzo- phenone (dioxycbenzone, Spectra-Sorb UV24)	0.5	—	0.5	1.0	15
UV-B absorbing agent					
4-(Dimethylamino)benzoic acid, 20 2-ethylhexyl ester (Escalol 507)	7.0	7.0	7.0	7.0	20
Emollients					
Mineral oil (Blandol)	13.48	13.98	13.48	13.48	
Squalane (Robane)	8.00	8.00	—	8.00	
25 Octyl palmitate (Ceraphyl 368)	—	—	8.00	—	25
Sesame oil	2.00	2.00	2.00	2.00	
Cocoa butter	0.50	0.50	0.50	0.50	
Emulsifiers					
30 Polyoxyethylene (3) oleyl ether (Oleth-3, Volpo 3)	3.50	3.50	3.50	3.50	30
Polyglyceryl-4 oleate (Witconol 14)	1.50	1.50	1.50	1.50	
35 Preservatives					35
Methylparaben (Tegosept M)	0.20	0.20	0.20	0.20	
Propylparaben (Tegosept P)	0.10	0.10	0.10	0.10	
Quaternium-15 (N- (3-Chloroallyl)- hexaminium chloride, Dowicil 200)	0.20	0.20	0.20	0.20	
40 Antioxidant					40
Propylene glycol and butylated hydroxyanisole and propyl gallate and citric acid 45 (Tenox 2)	0.02	0.02	0.02	0.02	45

- The formulations of examples 1 to 4 are prepared in substantially the same manner. The following is a detailed description of the preparation of the formula of Example 3.
- 50 3.5 kg. of polyoxyethylene (3) oleyl ether, 1.5 kg. of polyglyceryl-4 oleate, 7 kg. of 4-dimethylamino-benzoic acid, 2-ethylhexyl ester, 2.5 kg. of 2-hydroxy-4-methoxybenzophenone, 0.5 kg. of 2,2'-dihydroxy-4-methoxybenzophenone, 2 kg. of sesame oil, 13.48 kg. of mineral oil, 0.5 kg. of cocoa butter, 0.02 kg. of Tenox 2, and 0.1 kg. of propylparaben are blended with moderate mixing and heating at 92°-95°C. The mixing is continued until the blend is
- 55 uniform and clear at 92-95°C.
- Meanwhile, 5.5 kg. of polyethylene are slowly added to 8 kg. of octyl palmitate with high speed mixing for about 15 minutes until the polyethylene is completely dispersed.
- The polyethylene blend is then slowly added to the main blend with agitation at a temperature of 92-95°C. The mixing is continued until the oily blend is completely liquid and clear with no
- 60 undissolved particles of polyethylene visible.
- 54.5 kg. of deionized water are then heated to 92-95°C and 0.2 kg. of methylparaben are added with moderate mixing at this temperature. The mixing is continued until the methylparaben is completely dissolved.
- The aqueous solution is then slowly added to the oily blend with moderate mixing. When the
- 65 addition is completed, the mixing speed is increased until the batch is uniform. The batch is

maintained at 90–95°C.

The batch is then rapidly cooled to 60°C and mixed at this temperature for about 30 minutes and then cooled to 50°C with continued mixing. At the same time, 0.2 kg. of quaternium-15 are dissolved in 0.5 kg. of deionized water. This aqueous solution is then added slowly to the batch with mixing until the batch is again uniform, i.e., about 15 minutes. The resulting batch is then cooled to room temperature with continued mixing and then homogenized to yield 100 kg. of the final product.

#### Examples 5 and 6

Sunscreen formulations having a sun protection factor value of 7 and 8 respectively. The ingredients are listed on a weight percent basis and both the CTFA and trade name are included. Both formulations are water in oil type emulsions having a lotion consistency.

	5	6	
15			15
	<i>Deionized Water</i>	60.05	60.55
	<i>Polyethylene (homopolymer)</i>	3.50	3.50
20	(Allied Chemical A-C 617A, average molecular weight 1500, density of 0.91 g./cc.)		20
	<i>UV-A absorbing agent</i>	0.50	0.60
	2-Hydroxy-4-methoxybenzophenone (oxybenzone, Uvinyl M-40)		
25	<i>UV-B absorbing agent</i>	3.0	3.50
	4-(Dimethylamino)benzoic acid, 2-ethylhexyl ester (Escalol 507)		25
	<i>Humectant</i>		
	Propylene glycol	5.00	—
30	<i>Glycerin</i>	—	5.00
	<i>Emollients</i>		
	Mineral oil (Blandol)	11.48	—
	Mineral oil (Klearol)	—	20.88
	Pristane	10.00	—
35	<i>Emulsifiers</i>		35
	Polyoxyethylene (3) oleyl ether (Oleth-3, Volpo 3)	3.50	3.50
	Polyglyceryl-4 oleate (Witconol 14)	1.50	1.50
	Polysorbate 80 (Tween 80)	0.50	0.50
40	<i>Preservatives</i>		40
	Methylparaben (Tegosept M)	0.2	0.2
	Propylparaben (Tegosept P)	0.1	0.1
	Quaternium-15 (N(3-chloroallyl)-hexaminium chloride, Dowicil 200)	0.15	0.15
45	<i>Antioxidant</i>		45
	Propylene glycol and butylated hydroxyanisole and propyl gallate and citric acid (Tenox 2)	0.02	0.02
50	<i>Fragrance</i>	0.50	—
			50

These formulations are prepared according to the procedure set forth in the previous examples. The final products are lotions which are more fluid than the formulations of Example 1 to 4.

#### Examples 7 and 8

The following sunblock and sunscreen formulations can also be prepared according to the procedure of Example 3. Again, the ingredients are listed on a weight percent basis and both the CTFA and trade name are included. Both formulations are water in oil type emulsions. The formulation of Example 7 is a thick lotion or cream whereas that of Example 8 is more fluid

	7	8		
5	Deionized water	55.00	60.55	5
	Polyethylene (Vinyl acetate copolymer)	5.5	3.5	
	(Allied Chemical A-C 400, average molecular weight 3500, density of 0.92 g./cc.)			10
10	UV-A absorbing agents			
	2-Hydroxy-4-methoxybenzophenone (oxybenzone, Uvinul M-40)	2.5	0.6	
	2,2'-Dihydroxy-4-methoxybenzophenone (dioxybenzone, Spectra-Sorb UV24)	0.5	—	15
15	UV-B absorbing agent			
	4-(Dimethylamino)benzoic acid, 2-ethylhexyl ester (Escalol 507)	7.0	3.5	
20	Emollients			20
	Mineral oil (Blandol)	13.48	—	
	Mineral oil (Klearol)	—	20.88	
	Octyl palmitate (Ceraphyl 368)	8.00	—	
	Sesame oil	2.00	—	
25	Cocoa butter	0.50	—	25
	Humectant			
	Glycerin	—	5.0	
	Emulsifiers			
	Polyoxyethylene (3) oleyl ether (Olesh-3, Volpo 3)	3.0	3.50	30
30	Polyglyceryl-4 oleate (Witconol 14)	1.50	1.50	
	Polysorbate 80 (Tween 80)	—	0.50	
	Preservatives			
35	Methylparaben (Tegosept M)	0.20	0.20	35
	Propylparaben (Tegosept P)	0.10	0.10	
	Quaternium-15 (N- (3-Chloro-allyl)-hexaminium chloride, Dowicil 200)	0.20	0.15	
40	Antioxidant			40
	Propylene glycol and butylated hydroxyanisole and propyl gallate and citric acid (Tenox 2)	0.02	0.02	
45				45

#### Example 9

The UV absorption of two similar formulations one containing polyethylene (P) and the other without polyethylene (NP) are compared. The ingredients are listed on a weight percent basis.

50

		P	NP	
5	Deionized Water	55.00	55.00	5
	Polyethylene			
	(Allied Chemical A-C 6A)	5.50	—	
	UV-A absorbing agent			
	2-Hydroxy-4-methoxybenzo-	2.50	2.50	
10	phenone (oxybenzone, Uvinul M-40)			10
	2,2'-Dihydroxy-4-methoxybenzo-	0.5	0.5	
	phenone (dioxymethone, Spectra-Sorb UV24)			
15	UV-B absorbing agent			15
	4-(Dimethylamino)benzoic acid,	7.00	7.00	
	2-ethylhexyl ester (Escalol 507)			
	Emollients			
	Mineral oil (Blandol)	13.48	18.98	
20	Squalane (Robane)	8.00	8.00	20
	Sesame oil	2.00	2.00	
	Cocoa butter	0.50	0.50	
	Emulsifiers			
	Polyoxyethylene (3) oleyl ether	3.50	3.50	
25	(Oleth-3, Volpo 3)			25
	Polyglyceryl-4 oleate (Witconol 14)	1.50	1.50	
	Preservatives			
	Methylparaben (Tegosept M)	0.20	0.20	
	Propylparaben (Tegosept P)	0.10	0.10	
30	Quaternium-15 (N-(3-chloroallyl)-hexaminium chloride, Dowicil 200)	0.20	0.20	30
	Antioxidant			
	Propylene glycol and butylated hydroxyanisole and	0.02	0.02	
35	propyl gallate and citric acid (Tenox 2)			35

The two formulations are prepared in essentially the same manner and are evaluated *in vitro* according to the procedure of Cumpelik, "Analytical Procedures and Evaluation of Sunscreens", J. Soc. Cosmet. Chem., 23, p. 333-345 (1972).

Thin film samples of each formula are hot air dried and the ultraviolet absorbance is recorded at from 240 to 400 nm. Using these values, the percent of ultraviolet transmitted in the erythral (sun burning) region of 292.5 to 342.5 nm. and in the tanning region of 322.5 to 372.5 nm. are calculated. Of course, the greater the percent ultraviolet transmitted by the formulation the less protection it affords.

Each formulation is tested three times. For the polyethylene containing formulation (P), the relative average percent transmitted erythral is 5.105 and the relative average percent transmitted tan is 19.569. For the none polyethylene formulation (NP), the relative average percent transmitted erythral is 6.58 and the relative average percent transmitted tan is 55.23. Thus, the none polyethylene formulation (NP) transmitted 1.28 times the polyethylene formulation (P) in the erythral region and 2.82 times the polyethylene formulation in the tanning region.

## 55 CLAIMS 55

1. A sunscreen or sunblock composition which includes a homopolymer or copolymer of ethylene in an amount of from 2 to 15% by weight of the composition.
2. A sunscreen or sunblock composition according to Claim 1 and including 3% to 15% by weight of ultraviolet-absorbing agent, from 40% to 65% by weight of water, from 15% to 30% by weight of emollient, from 3% to 10% by weight of emulsifier, up to 1% by weight combined of preservative and antioxidant, and up to 1% by weight combined of fragrance and colouring agent.
3. The composition of Claim 2, wherein the ultraviolet absorbing agent includes one or more UV-A absorbing and one or more UV-B absorbing agents.
4. The composition of Claim 3, wherein the UV-A absorbing agent or agents is/are present



in an amount of from 0.5% to 10% by weight of the composition and the UV-B absorbing agent or agents is/are present in an amount of from 3% to 10% by weight of the composition.

5. The composition of Claim 4, wherein the UV-A absorbing agent is selected from one or more of 2-(2'-hydroxy-5'-methylphenyl) benzotriazole; 2-(2'-hydroxy-5'-*n*-octylphenyl) benzotriazole; 2,4-(dihydroxybenzophenone); 2-hydroxy-4-methoxybenzophenone; 2,2', 4,4'-tetrahydroxybenzophenone; 2,2'-dihydroxy-4,4'-dimethoxybenzophenone; 2,2'-dihydroxy-4-methoxybenzophenone; 2-ethylhexyl-4-phenylbenzophenone carbonate; 2-hydroxy-4-methoxy-4'-methylbenzophenone; 2-hydroxy-4-(*n*-octyloxy)benzophenone; 4-phenylbenzophenone; and 2-ethylhexyl-2-cyano-3,3'-diphenylacrylate and the UV-B absorbing agent is selected from one or more of 4-(dimethylamino)benzoic acid, ethyl ester; 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester; 4-(dimethylamino)benzoic acid, pentyl ester; glyceryl *p*-aminobenzoate; isobutyl *p*-aminobenzoate; and isopropyl *p*-aminobenzoate.

6. The composition of Claim 5, wherein the polyethylene is a homopolymer having a molecular weight of from 1100 to 2000 and a density of from 0.88 to 0.92 g./cc or is a copolymer of polyethylene and vinyl acetate having a molecular weight of from 2000 to 3500 and a density of from 0.91 to 0.93 g./cc.

7. The composition of Claim 6, wherein the UV-A absorbing agent is 2-hydroxy-4-methoxybenzophenone alone or in combination with 2,2'-dihydroxy-4-methoxybenzophenone and the UV-B absorbing agent is 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester.

8. The composition of Claim 7, being a water-in-oil emulsion, wherein the polyethylene is a homopolymer of molecular weight of from 1100 to 2000 and density of from 0.88 to 0.92 g./cc and is present in an amount of from 2.5% to 6% by weight of the composition.

9. The composition of Claim 8, comprising from 50% to 60% by weight of water, from 4.5% to 6% by weight of a polyethylene homopolymer, from 2.5% to 3.5% by weight of 2-hydroxy-4-methoxybenzophenone alone or in combination with 2,2'-dihydroxy-4-methoxybenzophenone, from 5% to 10% by weight of 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester, from 20% to 27% by weight of emollient, from about 4% to about 7% by weight of emulsifier, and up to about 1% by weight combined of preservative, antioxidant and fragrance.

10. The composition of Claim 9, comprising 55% by weight of deionized water, 5.5% by weight of a polyethylene homopolymer having an average molecular weight of 2000 and a density of 0.92 g./cc from 2.0% to 2.5% by weight of 2-hydroxy-4-methoxybenzophenone, up to 1% by weight of 2,2'-dihydroxy-4-methoxybenzophenone, 7% by weight of 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester, from 23% to 25% by weight of emollient, 5% by weight of emulsifier, and up to 1% by weight combined of preservative, antioxidant and fragrance.

11. The composition of Claim 10, consisting on a weight percent basis of:

	deionized water	55.0%	
	polyethylene	5.5%	
	2-hydroxy-4-methoxybenzophenone	2.5%	
40	2,2'-dihydroxy-4-methoxybenzophenone	0.5%	40
	4-(dimethylamino)benzoic acid, 2-ethylhexyl ester	7.0%	
	mineral oil	13.48%	
	squalane	8.0%	
45	sesame oil	2.0%	45
	cocoa butter	0.5%	
	polyoxyethylene (3) oleyl ether	3.5%	
	polyglyceryl-4 oleate	1.5%	
	methylparaben	0.2%	
50	propylparaben	0.1%	50
	quaternium-15	0.2%	
	propylene glycol, butylated hydroxyanisole, propyl gallate, and citric acid	0.02%	
55			55

12. The composition of Claim 10 consisting on a weight percent basis of:

	d ionized water	55.0%	
	polyethylene	5.5%	
	2-hydroxy-4-methoxybenzoph none	2.5%	
5	4-(dim thylamino)benzoic acid, 2-ethyl- hexyl ester	7.0%	5
	mineral oil	13.98%	
	squalane	8.0%	
	sesame oil	2.0%	
10	cocoa butter	0.5%	10
	polyoxyethylene (3) oleyl ether	3.5%	
	polyglyceryl-4 oleate	1.5%	
	methylparaben	0.2%	
	propylparaben	0.1%	
15	quaternium-15	0.2%	15
	propylene glycol, butylated hydroxy- anisole, propyl gallate, and citric acid	0.02%	

20 13. The composition of Claim 10 consisting on a weight percent basis of: 20

	deionized water	55.0%	
	polyethylene	5.5%	
25	2-hydroxy-4-methoxybenzophenone	2.5%	25
	2,2'-dihydroxy-4-methoxybenzophenone	0.5%	
	4-(dimethylamino)benzoic acid, 2-ethyl- - hexyl ester	7.0%	
	mineral oil	13.48%	
30	octyl palmitate	8.0%	30
	sesame oil	2.0%	
	cocoa butter	0.5%	
	polyoxyethylene (3) oleyl ether	3.5%	
	polyglyceryl-4 oleate	1.5%	
35	methylparaben	0.2%	35
	propylparaben	0.1%	
	quaternium-15	0.2%	
	propylene glycol, butylated hydroxy- anisole, propyl gallate, and citric acid	0.02%	
40			40

14. The composition of Claim 10 consisting on a weight percent basis of:

45	deionized water	55.0%	45
	polyethylene	5.5%	
	2-hydroxy-4-methoxybenzophenone	2.0%	
	2,2'-dihydroxy-4-methoxybenzophenone	1.0%	
	4-(dimethylamino)benzoic acid, 2-ethyl	7.0%	
50	hexyl ester		50
	mineral oil	13.48%	
	squalane	8.0%	
	sesame oil	2.0%	
	cocoa butter	0.5%	
55	polyoxyethylene (3) oleyl ether	3.5%	55
	polyglyceryl-4 oleate	1.5%	
	methylparaben	0.2%	
	propylparaben	0.1%	
	quaternium-15	0.2%	
60	Propylene glycol, butylated hydroxyanisole propyl gallate and citric acid	0.02%	60

65 15. The composition of Claim 8, which comprises from 55% to 65% of weight of water, 65

from 2.5% to 4.5% by weight of a polyethylene homopolymer, up to 1% by weight of 2-hydroxy-4-methoxybenzophenone, from 3% to 5% by weight of 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester, up to 7.5% by weight of humectant, from 20% to about 25% by weight of emollient, from 4% to about 7% by weight of emulsifier, and up to 1% by weight combined of preservative antioxidant and fragrance.

16. The composition of Claim 15, comprising from 60% to 61% by weight of deionized water, 3.5% by weight of a polyethylene homopolymer having an average molecular weight of about 1500 and a density of 0.91 g./cc, 0.6% by weight of 2-hydroxy-4-methoxybenzophenone, 3.5% by weight of 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester, 5% by weight of glycerin or propylene glycol from 20% to 22% by weight of emollient, from 5% to 6% by weight of emulsifier, and up to 1% by weight combined of preservative, antioxidant and fragrance.

17. The composition of Claim 16 consisting on a weight basis of:

15	deionized water	60.55%	15
	polyethylene	3.5%	
	2-hydroxy-4-methoxybenzophenone	0.6%	
	4-(dimethylamino)benzoic acid,	3.5%	
20	2-ethylhexyl ester		20
	glycerin	5.0%	
	mineral oil	20.88%	
	polyoxyethylene (3) oleyl ether	3.5%	
	polyglycerol-4 oleate	1.5%	
25	polysorbate 80	0.5%	25
	methylparaben	0.2%	
	propylparaben	0.1%	
	quatarnium-15	0.15%	
	lpropylene glycol, butylated	0.02%	
30	hydroxyanisole, propyl gallate, and citric acid		30

18. A sunscreen or sunblock formulation as claimed in Claim 2, and substantially as hereinbefore described with reference to any one of the foregoing individual Examples 1 to 8 or 9(p).

19. A method of enhancing the ultraviolet light absorbing properties of a sunscreen composition which contains one or more ultraviolet absorbing agent which comprises including at least 2% by weight of polyethylene within the composition.

20. The method of Claim 19, wherein the sunscreen composition contains from 3% to 15% by weight of ultraviolet absorbing agent and the polyethylene is included at from 2.0% to 15% by weight of the composition.

21. The method of Claim 20, wherein the composition contains from 0.5% to 10% by weight of one or more UV-A absorbing agents selected from the group consisting of 2-(2'-hydroxy-5'-methylphenyl)benzotriazole; 2-(2'-hydroxy-5'-*n*-octylphenyl)benzotriazole; 2,4-dihydroxybenzophenone; 2-hydroxy-4-methoxybenzophenone; 2,2',4,4'-tetrahydroxybenzophenone; 2,2'-dihydroxy-4,4'-dimethoxybenzophenone; 2,2'-dihydroxy-4-methoxybenzophenone; 2-ethylhexyl-4-phenylbenzophenone carbonate; 2-hydroxy-4-methoxy-4'-methylbenzophenone; 2-hydroxy-4-(*n*-octyloxy)benzophenone; 4-phenylbenzophenone; and 2-ethylhexyl-2-cyano-3,3'-diphenylacrylate and from 3% to 10% by weight of one or more UV-B absorbing agents selected from the group consisting of 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester; 4-(dimethylamino)benzoic acid, ethyl ester; 4-(dimethylamino)benzoic acid, pentyl ester; glyceryl *p*-aminobenzoate; isobutyl *p*-aminobenzoate; and isopropyl *p*-aminobenzoate.

22. The method of Claim 21, wherein the polyethylene is a homopolymer having a molecular weight of from 1100 to 2000 and a density of from 0.88 to 0.92 g./cc. or is a copolymer of polyethylene and vinyl acetate having a molecular weight of from 2000 to 3500 and a density of from 0.91 to 0.93 g./cc.

23. The method of Claim 22, wherein the UV-A absorbing agent is 2-hydroxy-4-methoxybenzophenone alone or in combination with 2,2'-dihydroxy-4-methoxybenzophenone and the UV-B absorbing agent is 4-(dimethylamino)benzoic acid, 2-ethylhexyl ester.

24. The method of Claim 23, wherein the composition also includes from 40% to 65% by weight of water, from 15% to 30% by weight of emollient, from 3% to 10% by weight of emulsifier, up to 1% by weight combined of preservative, and antioxidant, and up to 1% by weight combined of fragrance and colouring agent.

25. The method of Claim 24, wherein the composition is a water in oil emulsion containing

from 2.5% to 6% by weight of polyethylene and this polyethylene is a homopolymer of a low molecular weight of from 1100 to about 2000 and a low density of from 0.88 to 0.92 g./cc.

26. A method of reducing the erythematous and/or tanning effects of ultraviolet radiation which comprises applying to the skin a composition as claimed in any one of Claims 1 to 8.

5 27. The features hereinbefore disclosed, or their equivalents, in any novel selection.

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